PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 : B32B 5/16	A1	(11) International Publication Number: WO 90/11180 (43) International Publication Date: 4 October 1990 (04.10.90)

(21) International Application Number: PCT/US90/01506

(22) International Filing Date: 20 March 1990 (20.03.90)

(30) Priority data:
326,199 20 March 1989 (20.03.89) US

(71) Applicant: WEYERHAEUSER COMPANY [US/US]; Tacoma, WA 98477 (US).

(72) Inventors: NEOGI, Amar, N. ; 12531 17th Avenue N.E., Seattle, WA 98125 (US). YOUNG, Richard, H., Sr. ; P.O. Box 1153, Puyallup, WA 98371 (US).

(74) Agents: PETERSEN, David, P. et al.; Klarquist, Sparkman, Campbell, Leigh & Whinston, 121 S.W. Salmon Street, 1600 One World Trade Center, Portland, OR 97204 (US).

(81) Designated States: AT (European patent), AU, BE (European patent), CH (European patent), DE (European patent), DK (European patent), ES (European patent), FI, FR (European patent), GB (European patent), IT (European patent), JP, KR, LU (European patent), NL (European patent), NO, SE (European patent).

+

Published
With international search report.

(54) Title: A FIBER PRODUCT COATED WITH A DYE CONTAINING BINDER

(57) Abstract

Fibers are at least partially coated with a dye containing binder. The fiber product may be comprised of substantially unbonded fibers. Plural coatings of various binder materials may be applied to the entrained fibers. Also, one or more solid particulate materials may be adhered to the fibers by the binder material as the binder material dries. The binder material may be heat fusible or heat curable and fibers treated with this dye containing binder material may be mixed with other fibers for use in producing a wide variety of products. Various colors and shadings can be achieved by mixing different colored binder coated fibers and by mixing the treated fibers with untreated fibers.

+ See back of page

DESIGNATIONS OF "DE"

Until further notice, any designation of "DE" in any international application whose international filing date is prior to October 3, 1990, shall have effect in the territory of the Federal Republic of Germany with the exception of the territory of the former German Democratic Republic.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	ES	Spain	MG	Madagascar
AU	Australia	FI	Finland	ML	Mali
BB	Barbados	FR	France	MR	Mauritania
BE	Belgium	GA	Gabon	MW	Malawi
BF	Burkina Fasso	GB	United Kingdom	NL	Netherlands
BG	Bulgaria	HU	Hungary	NO	Norway
BJ	Benin	IT	Italy	RO	Romania
BR	Brazil	JP	Japan	SD	Sudan
CA	Canada	KP	Democratic People's Republic of Korea	SE	Sweden
CF	Central African Republic	KR	Republic of Korea	SN	Senegal
CG	Congo	LI	Liechtenstein	SU	Soviet Union
CH	Switzerland	LK	Sri Lanka	TD	Chad
CM	Cameroon	LU	Luxembourg	TG	Togo
DE	Germany, Federal Republic of	MC	Monaco	US	United States of America
DK	Denmark				

A FIBER PRODUCT COATED WITH A DYE CONTAINING BINDER

Background of the Invention

The present invention relates to a fiber product comprising discontinuous fibers which includes at least a partial coating of a binder material and a dye. The fiber product may also have solid particulate materials adhered to the fibers by the binder.

Dyed fibers are highly desirable for use in a number of applications. For example, in wet laid paper making applications, fibers are dyed in a dye solution and then used for making colored paper. However, equipment used in such paper making with fibers dyed in this manner is extremely difficult to clean due to the dye leaching into the white water of the process. This is particularly troublesome when it is desired to shift from one color of paper to another. It would be far preferable to have dyed fibers which can be used in such processes and in which the leaching of dye from the fibers is substantially eliminated.

It is also desirable in such applications to have individualized, as opposed to clumps of fibers, for this purpose.

Moreover, where dyed fibers are to be combined with other fibers, a mechanism for bonding the fibers together is also desirable.

A number of techniques for applying binders to webs of fibers are known. For example, U.S. Patent No. 4,600,462 of Watt describes a process in which an adhesive binder is sprayed onto one or both surfaces of an air laid cellulose fiber web. Submersion of the web in the adhesive binder is another method disclosed in this patent of applying the binder. Individual binder coated fibers for mixing with other fibers are not produced by this process. A hydrophile solution is also applied to the web. As another example, U.S. Patent Nos. 4,425,126 and 4,129,132 of Butterworth, et al. describe a fiberous material formed by combining thermoplastic fibers and wood

pulp, heat fusing the combined fibers, and thereafter depositing a binder on the heat fused web. Because the fibers are heat fused prior to adding the binder, individual binder coated fibers for mixing with other fibers are not produced by this process.

Some of these patents discuss the use of binders to adhere pigments and other solid particulate materials to fibers. However, none are understood to disclose the production of dyed binder coated fibers or such fibers which are substantially unbonded.

A need therefore exists for an improved fiber product with a binder coating containing a dye or colorant.

Summary of the Invention

In accordance with the present invention, a fiber product includes fibers at least partially coated with a binder which contains a dye. A substantial portion of the resulting bicomponent fibers are unbonded. By using an organic polymeric material as the liquid binder, and in particular a heat bondable liquid binder material, the fibers may be subsequently heated to fuse them together. The fibers may also be combined with other nontreated fibers and heat fused to provide a bonded web. By blending dyed fibers with undyed fibers or with fibers dyed with another color, various colors and shadings of color can be obtained.

Also, by using a water insoluble dye in the binder, the fibers may be used in wet laid paper applications without the dye leaching into the white water by-product of the paper making process. Substantial amounts of binder material may be applied to the fibers with the process still producing individualized coated and dyed fibers. However, it has been found that the first binder material must be applied in an amount of at least about seven percent of the combined dry weight of the binder material and fibers in order to produce a substantially continuous binder coating on the fibers. With a substantially continuous coating, little or no

surface area of the fibers is exposed and the desired characteristics added to the fibers by the binder material are not nullified or significantly altered by uncoated areas of the fiber. With a binder level of at least about 10 percent of the combined dry weight of the binder material and fibers, and with the binder material being heat fusible, the coated fibers are capable of bonding relatively strongly to one another when heat fused. In addition, binder levels of 30 percent to 50 percent and higher, such as above 90 percent and with no maximum limit yet having been determined, can be obtained using the process of the present invention, while still resulting in a product comprised of substantially unbonded individualized fibers. At these higher levels of binder, the treated fibers may readily be mixed or blended with untreated fibers and used in heat fusing the blended fibers. Also, higher binder levels are preferably used to adhere solid particulate materials to the fibers as explained below.

As another aspect of the present invention, one or more solid particulate materials may be adhered to the fibers by the binder material. Solid particulate material is applied to the fibers while the liquid binder material on the fibers is still at least partially wet. As the liquid binder material dries, the particulate material is adhered to the fibers. Although not limited to specific materials, the particulate materials may comprise at least one material selected from the group comprising a pigment material, a super absorbent material, an abrasive material, an oleophilic material, an electrically conductive material and a fire retardant material.

In accordance with the invention, more than one binder material may be applied to the fibers, such as a thermoset binder material followed by a thermoplastic binder material, with or without solid particulate material being adhered to the fibers by the binder. Again, substantially individualized dyed fibers containing these plural binder materials can be produced.

Although not as beneficial for many applications, such as when the properties of individual fibers are desired, in addition to individual fibers, fiber bundles may also be treated in accordance with the process of the present invention. A fiber bundle is an interconnected group of two or more fibers that are not separated during processing. Fiber bundles, like individual fibers, are much longer than wide. For example, when mechanically fiberized wood is produced, some individual fibers result along with bundles of fibers that are not separated during the mechanical fiberization process.

It is accordingly one object of the present invention to provide discontinuous fibers which are at least partially coated with one or more binder materials containing a dye.

It is another object of the present invention to provide a fiber product of binder coated dyed fibers which are substantially individualized or unbonded.

A further object of the present invention is to provide a fiber product of binder coated dyed discontinuous fibers with the binders being applied in an amount which is sufficient to substantially continuously coat the fibers or in much higher amounts, while still resulting in substantially individualized or unbonded fibers.

A still further object of the present invention is to provide a fiber product of binder coated dyed fibers to which one or more solid particulate materials, which impart functional benefits to the fibers, are adhered to the fibers by the binder material.

Another object of the present invention is to provide substantially individualized discontinuous fibers coated with a heat fusible dye containing binder material, with or without particulate materials adhered thereto, and in which the binder may be subsequently heated to bond the fibers, with or without additional untreated fibers being added.

Still another object of the present invention is to provide binder coated dyed fibers in which leaching of dye into white water of a wet laid paper making process is minimized.

A subsidiary object of the present invention is to also treat fiber bundles in the same manner as the individualized fibers are treated.

These and other objects, features and advantages of the present invention will be apparent with reference to the following detailed description and drawings.

Brief Description of the Drawings

Fig. 1 is a schematic illustration of one form of apparatus in which discontinuous fibers can be treated to provide a fiber product in accordance with the present invention.

Fig. 2 is a side elevational section view of one form of binder application mechanism which can be used to apply liquid binder material to discontinuous fibers in accordance with the method of the present invention.

Fig. 3 is a front elevational section view of the binder application mechanism of Fig. 2.

Fig. 4 is a schematic illustration of another form of binder application mechanism which can be used to produce the fiber product of the present invention.

Fig. 5 is a schematic illustration of an alternative apparatus used to produce the fiber product of the present invention.

Fig. 6 is a schematic illustration of another apparatus for producing the fiber product of the present invention.

Detailed Description of the Preferred Embodiments

The present invention is a fiber product comprised of treated discontinuous synthetic and natural fibers. The term discontinuous fibers refers to fibers of a relatively short length in comparison to continuous fibers treated during an extrusion process used to produce such fibers. The term discontinuous fibers also includes fiber bundles. The term individual fibers refers to

fibers that are comprised substantially of individual separated fibers with at most only a small amount of fiber bundles. Chopped or broken synthetic fibers also fall into the category of discontinuous fibers. Although not limited to any particular type of fiber, the synthetic fibers commonly are of polyethylene, polypropylene, acrylic, polyester, rayon and nylon. Discontinuous fibers of inorganic and organic materials, including cellulosic fibers are also included. The natural fibers may likewise be of a wide variety of materials, with chopped silk fibers, wood pulp fibers, bagasse, hemp, jute, rice, wheat, bamboo, corn, sisal, cotton, flax, kenaf, and the like, and mixtures thereof, being several examples.

Wood pulp fibers can be obtained from well-known chemical processes such as the kraft and sulfite processes. Suitable starting materials for these processes include hardwood and softwood species, such as alder, pine, douglas fir, spruce and hemlock. Wood pulp fibers can also be obtained from mechanical processes, such as ground wood, refiner mechanical, thermomechanical, chemi-mechanical, and chemi-thermomechanical pulp processes. However, to the extent such processes produce fiber bundles as opposed to individually separated fibers or individual fibers, they are less preferred. However, treating fiber bundles is within the scope of the present invention. Recycled or secondary wood pulp fibers and bleached and unbleached wood pulp fibers can also be used. Details of the production of wood pulp fibers are well-known to those skilled in the art. These fibers are commercially available from a number of companies, including Weyerhaeuser Company, the assignee of the present patent application.

For purposes of convenience, and not to be construed as a limitation, the following description proceeds with reference to the treatment of individual chemical wood pulp fibers. The treatment of individual fibers of other types and obtained by other methods, as

well as the treatment of fiber bundles, can be accomplished in the same manner.

When relatively dry wood pulp fibers are being treated, that is fibers with less than about 10 to 12 percent by weight moisture content, the lumen of such fibers is substantially collapsed. As a result, when binder materials, in particular latex binder materials, are applied to these relatively dry wood pulp fibers, penetration of the binder into the lumen is minimized. In comparison, relatively wet fibers tend to have open lumen through which binder materials can flow into the fiber in the event the fiber is immersed in the binder. Any binder that penetrates the lumen contributes less to the desired characteristics of the treated fiber than the binder which is present on the surface of the fiber. Therefore, when relatively dry wood pulp fibers are treated, less binder material is required to obtain the same effect than in the case where the fibers are relatively wet and the binder penetrates the lumen.

Binders used to treat the fibers broadly include dye containing substances which can be applied in liquid form to entrained fibers during the treatment process. The term dye refers broadly to a colorant which can be mixed with the binder. Preferably the dyes are in liquid form. However, the colorants or dyes may comprise pigments in solid particulate form, such as mixed with the binder and then applied with the binder to the fibers. As explained below, the dye and binder is preferably applied by spraying. These binder materials are preferably of the type which are capable of subsequently binding the fibers produced by the process to one another or to other fibers during the manufacture of webs and other products using the treated fibers. Most preferably these binders comprise organic polymer materials which may be heat fused or heat cured at elevated temperatures to bond the fibers when the fibers are used in manufacturing products. Also, in applications where solid particulate material is to be adhered to the fibers by the binder, the binder must be of

a type which is suitable for this purpose. Also, the binder is of the type which can be mixed with or otherwise contains a dye or colorant. If a water insoluble dye is included in the binder, the dye remains with the fibers, rather than leaching into aqueous solutions used, for example, in wet laying applications of the treated fibers. Also, dye would not leach from towels and other products made from these fibers when these products are used, for example, to wipe up liquids.

Suitable binders include polymeric materials in the form of aqueous emulsions or solutions and nonaqueous solutions. To prevent agglomeration of fibers during the treatment process, preferably the total liquid content of the treated fibers during treatment, including the moisture contributed by the binder, together with the liquid content of the fibers (in the case of moisture containing fibers such as wood pulp), must be no more than about 45 to 55 percent of the total weight, with a 25 to 35 percent moisture content being more typical. Assuming wood pulp is used as the fiber, the moisture contributed by the wood pulp can be higher, but is preferably less than about 10 to 12 percent and more typically about six to eight percent. The remaining moisture or liquid is typically contributed by the binder. These polymer emulsions are typically referred to as "latexes." In the present application, the term "latex" refers very broadly to any aqueous emulsion of a polymeric material. The term solution means binders dissolved in water or other solvents, such as acetone or toluene. Polymeric materials used in binders in accordance with the present method can range from hard rigid types to those which are soft and rubbery. Moreover, these polymers may be either thermoplastic or thermosetting in nature. In the case of thermoplastic polymers, the polymers may be a material which remains permanently thermoplastic. Alternatively, such polymers may be of a type which is partially or fully cross-linkable, with or without an external catalyst, into a thermosetting type polymer. As a few specific examples,

suitable thermoplastic binders can be made of the following materials:

ethylene vinyl alcohol
polyvinyl acetate
acrylic
polyvinyl acetate acrylate
acrylates
polyvinyl dichloride
ethylene vinyl acetate
ethylene vinyl chloride
polyvinyl chloride
styrene
styrene acrylate
styrene/butadiene
styrene/acrylonitrile
butadiene/acrylonitrile
acrylonitrile/butadiene/styrene
ethylene acrylic acid
polyethylene
urethanes
polycarbonate
polyphenylene oxide
polypropylene
polyesters
polyimides

In addition, a few specific examples of thermoset binders include those made of the following materials:

epoxy
phenolic
bismaleimide
polyimide
melamine/formaldehyde
polyester
urethanes
urea
urea/formaldehyde

As explained more fully below, in accordance with the method of the present invention, more than one of

these dye containing materials may be used to treat the discontinuous fibers. For example, a first coating or sheath of a thermoset material may be used followed by a second coating of a thermoplastic material. Different fiber colors may be achieved by including one color of dye in the first coating and another color dye in the second coating. During subsequent use of the fibers to make products, the thermoplastic material may be heated to its softening or tack temperature without raising the thermoset material to its curing temperature. The remaining thermoset material permits subsequent heating of the fibers to cure the thermoset material during further processing. Alternatively, the thermoset material may be cured at the same time the thermoplastic material is heated by heating the fibers to the curing temperature of the thermoset material while the thermoplastic material is also being heated to its tack temperature.

Certain types of binder enhance the fire resistance of the treated fibers, and thereby of products made from these fibers. For example, poly vinyl chloride, poly vinyl dichloride, ethylene vinyl chloride and phenolic are fire retardant.

Surfactants may also be included in the liquid binder as desired. Other materials may also be mixed with the liquid binder to impart desired characteristics to the treated fibers.

In addition, one or more solid particulate materials may be adhered to the fibers to provide desired functional characteristics. The solid particulate materials are applied to a binder wetted surface of the fibers and are then adhered to the fibers by the binder as the binder dries. In this case, heat curing or heat fusing of the binder is not required to adhere the particles to the fibers. Although not limited to specific materials, examples of suitable particulate materials include pigments, such as titanium dioxide; fire retardant materials, such as alumina trihydrate and antimony oxide; electrically conductive materials, such as metallic

powders and carbon black; abrasive materials, such as ceramics, grit and metallic powders; acidular materials, such as clay, talc and mica, used as paper making additives; oleophilic materials; hydrophobic materials; and hydrophilic materials, such as super absorbent particles; insecticides; and fertilizers. Thus, the solid particulate materials are not limited to narrow categories.

The super absorbent particulate materials are granular or powdered materials which have the ability to absorb liquids, including body fluids. These super absorbents are generally hydrophilic polymeric materials. Super absorbents are defined herein as materials which exhibit the ability to absorb large quantities of liquids, i.e. in excess of 10 to 15 parts of liquid per part thereof. These super absorbent materials generally fall into three classes, namely, starch graft copolymers, cross-linked carboxymethylcellulose derivatives and modified hydrophilic polyacrylates. Without limiting the generality of the term super absorbent, examples of super absorbents include carboxylated cellulose, hydrolyzed acrylonitrile-grafted starch, acrylic acid derivative polymers, polyacrylonitrile derivatives, polyacrylamide type compounds and saponified vinyl acetate/methyl acrylate copolymers. Among these polymers, acrylic acid derivative copolymers are especially preferred. Specific examples of super absorbent particles are marketed under the trademarks "Sanwet" (supplied by Sanyo Kasei Kogyo Kabushiki Kaisha) and "Sumika Gel" (supplied by Sumitomo Kagaku Kabushiki Kaisha).

An abrasive is a hard substance that, in particulate form, is capable of effecting a physical change in a surface, ranging from the removal of a thin film of tarnish to the cutting of heavy metal cross sections and cutting stone. Abrasives are used in scores of different abrasive products. The two principal categories of abrasives are: (1) natural abrasives, such as quartz, emery, corundum, garnet, tripoli, diatomaceous

earth (diatomite), pumice, and diamond; and (2) synthetic abrasives, such as fused alumina, silicon carbide, boron nitride, metallic abrasives, and synthetic diamond.

Oleophilic materials are those capable of rapid wetting by oil while hydrophilic materials are those capable of rapid wetting by water.

Pigments, dyes or colorants can broadly be defined as being capable of reemitting light of certain wavelengths while absorbing light of other wavelengths and which are used to impart color.

Electrically conductive materials are those which readily conduct electric current.

In addition, fire retardant materials are those which reduce the flammability of the fibers to which they are attached. Preferably these materials are active fire retardants in that they chemically inhibit oxidation or they emit water or other fire suppressing substances when burned.

With reference to Fig. 1, a sheet of chemical wood pulp 10 is unrolled from a roll 12 and delivered to a refiberizing apparatus, such as a conventional hammer mill 14. The sheet 10 is readily converted into individual fibers 16 within the hammer mill. These individual fibers are delivered, as by a conveyor 18, to a fiber loading zone 20 of a fiber treatment apparatus. In the case of a continuous process, fibers 16 are continuously delivered to the zone 20. In a batch or semi-batch process, fibers are loaded at zone 20 at intervals.

In the Fig. 1 fiber treatment apparatus, loading zone 20 forms part of a fiber treatment conduit 24. The illustrated conduit 24 comprises a recirculating loop. A blower or fan 26 in loop 24 is positioned adjacent to the fiber loading zone 20. Blower 26 is capable of moving a gaseous medium, such as air, at a velocity and volume sufficient to entrain the fibers which have been loaded into zone 20. The entrained fibers circulate in a direction indicated by arrow 28 through the loop and pass through the loading zone 20 and blower 26 each time the

loop is traversed. The velocity of air traveling in the loop is preferably set at a level where solids are uniformly dispersed and transported by the air flow. In addition, the velocity is preferably established at a level which is sufficient to avoid saltation, that is the dropping of solids or liquids from a horizontal air stream. As a specific example, when Type NB316 chemical wood pulp, available from Weyerhaeuser Company, was used as the fiber, a velocity of 5,000 feet per minute worked extremely well for treatment of these fibers in accordance with the method. However, this velocity can be varied and adjusted for optimum results.

Also, the ratio of the volume of air per pound of entrained fiber is variable over relatively large ranges. One suitable example is 23.4 ft of air per pound of fiber. As another example, 11.7 ft of air per pound of fiber produced equivalent results.

The entrained fibers traveling in the loop pass one or more binder material application zones, with one such zone being indicated in Fig. 1 at 30. This binder material application zone 30 forms a part of the conduit 24. A mechanism is provided at the binder application zone for applying a liquid binder solution to the entrained fibers. In the Fig. 1 form of this mechanism, plural nozzles, in this case nozzles 32, 34 and 36, are used to apply the liquid binder material. These nozzles produce an atomized spray or mist of binder drops which impact and coat the fibers as the fibers pass the nozzles.

In the Fig. 1 apparatus, plural valves 40, 42 and 44 are operated to control the flow of liquid binder material to the respective nozzles 32, 34 and 36. In the illustrated configuration, a first liquid binder material from a tank or other source 46 is delivered to the three nozzles 32, 34 and 36 when valves 40 and 42 are open and valve 44 is closed. As the fibers recirculate through the conduit 24, and each time they pass the nozzles, an additional amount of the first liquid binder material is applied. Different surfaces of the fibers are exposed to

the nozzles 32, 34 and 36 as the fibers travel through the material application zone 30. After the desired amount of the first liquid) binder material is applied, the valve 40 is closed. If desired for a particular application, a second liquid binder material from a tank or other source 48 may also be applied to the fibers. With valves 42 and 44 open and valve 40 closed, this second liquid binder material is applied to the fibers through each of the nozzles 32, 34 and 36. In addition, the two liquid binder materials may be simultaneously applied, at successive locations in zone 30. For example, the valve 42 may be closed and valve 44 opened so that the first liquid binder material is applied through nozzles 32, 34 and the second liquid binder material is applied through nozzle 36. More than two types of liquid binder materials may be applied by adding additional binder sources and suitable valving and nozzles.

In general, the material application zone 30 typically ranges from two to one hundred feet long, with longer application zones allowing the application of binder over a longer period of time during passage of fibers through the material application zone. Also, longer material application zones facilitate the use of more nozzles spaced along the length of the zones.

The nozzles 32, 34 and 36 are commercially available and produce a fine mist of droplets. Typically, these nozzles provide a fan spray. Any suitable nozzles may be used, but it is desirable that the nozzles not produce a continuous stream of liquid binder material, but instead produce droplets or a mist of such material. The nozzles are typically spaced apart from three to four feet along the length of the conduit, although they may be closer or further apart as desired.

Virtually any amount of dye containing binder material may be applied to the entrained fibers. However, it has been found that the application of binder must be at a minimum of about seven percent of the dry weight of the combined fibers and binder in order for the fibers to

have a substantially continuous sheath or coating of the binder material. If the fibers lack a continuous coating, it becomes more difficult to adhere significant amounts of particulate material to the binder in the manner explained below. In fact, a much higher percentage of binder than this minimum is preferably used to adhere particles to the fibers. Also, exposed portions of the core fiber, that is surface areas of the fiber not coated with the binder, lack the desired characteristics of the binder. For example, if a hydrophobic binder is used to cover a water absorbing cellulose material, failure to completely enclose the material with the coating leaves exposed surfaces of the fiber which can absorb water. Also, any uncoated areas on the fibers would not bond to other untreated fibers during subsequent heat bonding of the treated and untreated fibers.

It has also been found that, with a binder concentration of about 10 percent by dry weight of the weight of the fiber and binder combination, the fibers, when heat fused, will bond somewhat strongly to other fibers coated in a similar manner, but less strongly to untreated fibers. The resulting bond strength is similar to the strength achieved when fibers coated with a 40 percent by dry weight binder amount are mixed with untreated fibers in a ratio of one part treated fibers to three parts untreated fibers. A binder concentration by dry weight of the combined binder and fibers of from 30 percent to 50 percent has proven extremely suitable for use in mixing with other fibers, heat bonding, and use in forming products such as absorbent pads.

Binder concentrations in excess of 50 percent, for example 90 percent or more, can be achieved utilizing the present invention. To achieve these extremely high binder concentrations, one preferred approach is to apply a first amount of the binder material to the entrained fibers, continue to recirculate the fibers until this first layer or coating of binder material is substantially dry, and then apply a second coating of the binder

material. Third, fourth and subsequent coatings can be applied to the entrained fibers as necessary to achieve the desired level of binder material.

Following the application of the dye containing liquid binder material to the fibers, the fibers may be retained in the loop until they have dried. The recirculation of the fibers may then be stopped and the fibers removed at the loading zone 20, which then functions as a fiber removal location. However, in the Fig. 1 apparatus, a cyclone separator 60 is selectively connected by a conduit section 61 and a gate valve 62 to the conduit 24. At the same time a valve 64 is opened to allow air to enter the loop 24 to compensate for air exiting through the separator 60. With the separator in the loop, the entrained fibers are collected in the separator and then removed from the separator at a fiber removal outlet 66. A substantial majority of the fibers processed in this manner are unbonded to one another by the binder material. By substantial majority, it is meant that at least about 70 percent of the fibers remain unbonded. More specifically, in tests conducted as of this time, the resulting treated fibers are substantially unbonded, meaning that approximately 95 percent of the treated fibers have been found to be unbonded to one another by the binder material. An optional means for heating the binder coated fibers may be included in conduit 24. For example heated air may be blended with the air flowing through the conduit. Similarly, a heater 70 may be included in conduit 24 for heating the fibers. This added heat accelerates the drying of the liquid binder. In the event a thermoplastic heat fusible binder is used, the fibers are preferably heated above the film forming temperatures of the binder and below the hot tack temperature at which the binder becomes tacky so that the binder coated fibers may subsequently be heat fused during processing of the fibers into products. Also, if a thermoset heat fusible binder is used, the fiber temperature is preferably maintained below the curing

temperature of the binder so that the binder coated fibers may be subsequently heat cured during the processing of the binder coated fibers into products.

The fibers are preferably not heated prior to the application of the binder material. It has been found that heating the fibers results in elevated temperatures at the binder application zone 30. These elevated temperatures cause some of the binder to at least partially dry (coelesce) before reaching surfaces of fibers passing through the binder application zone 30. The solidified binder tends to either not adhere, or only adhere weakly, to the fibers. In addition, droplets of binder which impinge heated fibers tend to dry in globules on the fibers, rather than spread across the surface of the fibers to provide a substantially continuous uniform coating thereon.

The dried fibers from outlet 66 of the cyclone separator 60 may be deposited in a conventional baling apparatus 72. To prevent bonding of the fibers in the baler, the fibers are at a temperature which is below their curing or tack temperature under the pressure applied by the baler. When compressed, these fibers remain unbonded by the binder material and therefore can be readily separated into individualized fibers for subsequent use.

Also, treated fibers which have only been partially dried, and thus which are still somewhat wet with the binder material, may be deposited from outlet 66 loosely onto a conveyor 74 or in a loose uncompressed pile at a collecting zone (not shown). These fibers can then be allowed to dry. Alternatively, the treated fibers may be carried by the conveyor 74 through a heater 76, operable like heater 70, to accelerate the drying of the fibers. The resulting product again contains a major portion of unbonded fibers. However, the wetter the fibers and more dense the resulting web when deposited on belt 74, or in a pile, the more binder-to-binder bonds that occur. Thus, in many cases it is preferable to at

least partially dry the fibers within the conduit 24 prior to removing the fibers therefrom. However, the fiber may be air laid either dry or wet, that is with no more than about a 55 percent total moisture content in the fibers and binder thereon, directly into a web which can then be processed into various products, such as into disposable diapers with the core of the diaper being formed by the web. Air laying refers to the transfer of the fibers through air or another gaseous medium.

Solid particulate materials, such as super absorbent particles and other materials, may be adhered to the fibers by the binder material.

To accomplish this, the solid particulate material is added to the loop 24, such as at the fiber loading zone 20. The particles may also be added to the loop 24 from a supply housing 80, using a feed screw metering device or other conventional injection mechanism. Preferably, the particles are added after the fibers have been wetted with the binder material. Consequently, the particles will not be covered with the binder material, which could interfere with the desired attributes contributed by the particles. These particles contact the wet binder material on the surfaces of the fibers and stick to the binder material. As the binder material dries, the particles remain stuck to the surface of the treated fibers. In one specific approach, the fibers are treated with a binder, circulation of the fibers is stopped momentarily to allow the addition of the solid particulate material at the fiber loading zone 20, and recirculation and entrainment of the fibers is recommenced. The particles mix with and are secured to the surface of the fibers by the liquid binder material as the binder dries. Although lower concentrations are effective in binding particles to fibers, it has been found that relatively high levels of binder concentrations, for example 20 percent or more of the dry weight of the binder, fiber and additive, produces the best adhesion of particles to the fibers. A 50 percent

binder concentration would perform better in adhering particles to the fibers than a 20 percent binder concentration in many applications. These higher binder levels, when heat fusible binders are used, facilitate subsequent heat fusion of the fibers and strong bonding, with or without other fibers being added, during use of the fibers in manufacturing products.

The Fig. 1 apparatus may be operated in a batch mode in which fibers are introduced, fully treated and removed. Alternatively, a semi-batch approach may be used in which fibers are added and some, but not all, of the fibers removed from the loop. Also, the Fig. 1 apparatus may be operated in a continuous mode in which fibers are introduced at zone 20 and removed by the cyclone separator 60 with or without recirculating through the loop. The gate valves 62, 64 may be opened to a desired extent to control the amount of fiber that is removed. This quantity of removed fiber is preferably equal to the amount of untreated fiber that is introduced into the loop. In this nonrecirculating case, the zone 30 is typically expanded.

With reference to Figs. 2 and 3, another mechanism for applying binder material to the fibers is illustrated. Rather than using external spray nozzles such as 32, 34 and 36, plural nozzles (i.e., one being shown as 82 in Figs. 2 and 3) are included in the conduit at the binder material applying zone 30. The nozzle 82 applies a fine spray of liquid binder material onto the fibers 16 as they move past the nozzle. The Figs. 2 and 3 binder applying mechanism includes a means for imparting turbulence to the air as it passes the nozzles. As a result, the fibers 16 tend to tumble in front of the nozzles and expose different surfaces to the applied binder material. The illustrated turbulence imparting mechanism comprises a blunted conical air deflection baffle 86 supported within the conduit 24 by rods, with two such rods 88 and 90 being shown. Rod 90 may be hollow to provide a pathway through which binder material is

delivered to the nozzle 82. Of course, other turbulence imparting mechanisms may also be used.

In Fig. 4, a rotary mixer 90 with plural mixing paddles, some being indicated at 92, is disposed within the conduit 24 at the material applying zone 30. This mixer is rotated by a motor (not shown) to impart turbulence to fibers as they pass the mixer paddles. The nozzles 32, 34 and 36 are disposed externally of the conduit 24 for directing the binder material through ports to the fibers passing the mixer. These nozzles may be enclosed in a shroud or cover as shown by dashed lines 94 in this figure. However, in the Fig. 4 approach, blower 26 has been shifted to a location downstream from the material applying zone 30. Consequently, the material applying zone is at a relatively low pressure with a slight vacuum being present in the material applying zone relative to the pressure outside the conduit at this zone. Consequently, fibers passing the nozzles 32, 34 and 36 tend to be drawn into the conduit rather than escaping through the binder applying ports. As a result, the nozzles can be positioned outside of the conduit where they are not subject to being clogged by the passing fibers.

Referring to Fig. 5, another apparatus is shown for producing the fiber product of the present invention. In Fig. 5, for purposes of convenience, elements in common with those of Fig. 1 have been given like numbers and will not be discussed in detail.

In general, the Fig. 5 form of the apparatus allows the continuous processing of fibers with the fibers passing only once through the dye containing binder material application zone 30. However, the zone 30 is typically of an extended length with more nozzles (i.e. six to twelve or more) than shown in Fig. 5. Following the application of the binder material, solid particulate material may be added from source 80, such as by a blower (not shown) or a feed screw, to introduce the particles into the stream of entrained fibers. The fibers pass

through a heater or oven 70, or heated air is blended with the air stream which entrains the fibers, for drying purposes and then travel through a distance D at the elevated temperatures created by this heat. As a typical example, D may be 150 feet with the time required to travel the distance D enabling the binder on the entrained fibers to become substantially dry. Optionally, cooling air from a refrigeration unit 100 or from the environment may be delivered by a blower 102 to the conduit 24 at a location 104 in the conduit. This cooling air lowers the temperature of the dried and treated fibers. The cooling air may be dehumidified prior to introduction to conduit 24 to minimize any condensation that may otherwise occur in the conduit. Where thermosetting binders are used, preferably the added heat does not elevate the temperature of the fibers to a level which cures the thermosetting binder. Consequently, the binders may subsequently be heat cured when the treated fibers are thereafter used in manufacturing. Also, where thermoplastic binders are used, the temperature is preferably kept above the film forming temperature and below the hot tack temperature of the thermoplastic binder material. Cyclone separator 60 may be provided with a bleed line 106 for venting the air during separation. Although less preferred, this air may be recirculated back to the fiber loading zone 20. Flow control gate valves 107, 109 may be included in the system to balance the air flow through the various conduits of the illustrated system.

The treated fibers from outlet 66 of the separator 60 may be fed to a hopper 110 of a conventional fiber blending unit 112. Other fibers, such as wood pulp fibers or synthetic fibers are fed, in a desired proportion for the resulting product, by way of a conduit 114 to another hopper 116 and then to the blending unit 112. The fibers from outlet 66 can also be used without blending them with other fibers. The blended treated and untreated fibers 118 are shown being deposited on a facing sheet 120 which is passed through the blending unit 112

from a roll 122. The fibers may also be deposited directly on a conveyor without a facing sheet. The facing sheet is carried by a conveyer 124 through the blending unit 112. The composite web is then passed through a thermobonding unit 130 which raises the temperature of the fibers sufficiently to cause the treated fibers to heat fuse to the other fibers and to the facing sheet. The fibers may be compressed to densify the web prior to or following the delivery to the thermobonder 130. A cover sheet may also be added to the product before or after the thermobonder 130. Following thermobonding, to reduce the stiffness of the webs, they may be "tenderized" by the use of a mechanism which mechanically breaks up some of the bonds in the web. The web still remains substantially bonded, however. As one example, the webs may be passed through the nips of cross machine direction and machine direction corrugators to reduce their stiffness. The stiffness can be controlled by adjusting the clearance between the nips. Although not limited to a specific approach, examples of suitable corrugators and tenderizing procedures are disclosed in U.S. Patent Nos. 4,559,050; 4,596,567; and 4,605,402. The resulting material can be used in a conventional manner to manufacture a wide variety of products, such as absorbent pads, disposable diapers, webs and the like. The dyed fibers thus impart a desired coloration to the products.

In the Fig. 6 form of apparatus used to produce the fiber product of the present invention, the fibers to be treated may be delivered in loose form or in the form of a sheet 10 from roll 12 to a first hammer mill or refiberizing device 140. The resulting fibers travel through air or another gaseous medium in conduit 24 and through a binder applying zone 30. If the fibers are not conveyed horizontally but merely pass downwardly in the conduit, the air velocity need not be as high. In this sense the fibers are not air entrained, but merely travel through the conduit. At zone 30, a first binder material 46 is applied to the fibers by way of nozzle 32. Again,

this is a schematic representation of the apparatus, as plural nozzles are preferably employed and more than one type of binder may be used. Thus, the material applying zone is substantially elongated over that which is shown. One or more particulate materials may also be added to the binder coated fibers from a source of such particles 80. The treated fibers may be air laid or otherwise deposited, wet or dry, directly on a face sheet 120 from a roll 122 or directly on a conveyor. Typically a vacuum (not shown) is used to draw the fibers against the screen so that the fibers are not simply falling under the influence of gravity. The face sheet is carried by a conveyor 124 past an outlet 146 of the fiber treatment apparatus. A web of untreated fibers 148 from a roll 150 is optionally delivered to another hammer mill 152 for fiberization and blending with the treated fibers prior to depositing the blend on the face sheet 120. The face sheet 120 and deposited fibers may then be processed, such as previously described, for use in manufacturing a variety of products.

The following examples will serve to more specifically illustrate the product of the present invention, although it is to be understood that the invention is not limited to these examples.

EXAMPLE 1

A bleached Kraft Southern Pine cellulose fiber pulp sheet (NB-316 from Weyerhaeuser Company) was fiberized in a hammer mill. The resulting fiberized wood pulp fluff was then air entrained in a Waring blender. Two binder solutions were prepared containing water insoluble dyes or colorants, Morton Purple KI and Hytherm Black B. Each solution contained 50 percent acetone and 50 percent of one of the dyes. Each dye solution was added to a 45 percent solids latex binder, namely Synthemul 40-800, so that the dye equalled 5 percent of the latex solids by weight. Synthemul 40-800 is available from Reichhold Chemical Corporation. The two dye-containing binders were then applied to the entrained cellulose fibers. The fibers were pigmented by the dye

and had a substantially continuous binder and dye coating. The fibers were also substantially unbonded. The latex and dye mixture was 30 percent of the combined dry weight of the binder, dye and fibers. These pigmented fibers were allowed to dry and then used to prepare a 1 percent suspension in water. After one hour, this suspension was filtered through a Buchner funnel. Examination revealed that the residues were pigmented fibers and the filtrates were clear water. If these pigmented fibers had been used in a wet laid paper making process, the dye would be substantially retained on the fiber and would not leach significantly into water used in the process. Also, dye or colorant would not leach from towels and other products made from these fibers when these products are used, for example to wipe up liquids. Consequently, colored paper board may be manufactured using these fibers without requiring the addition of dye to water. Once dye is added to water in paper making equipment, it is difficult to remove the dye from the equipment in order to, for example, change colors of paper. This problem can be avoided by incorporating the dye or colorant in the binder. Particulate pigment materials may be mixed with the binder and sprayed onto the fiber to form pigmented or dyed fiber. For example, particles of TiO_2 may be applied in this manner. Treatment of fibers in the systems of Figs. 1, 5 and 6 would also produce dyed fiber with these characteristics.

Even though wood fibers are of irregular cross-section and thus more difficult to coat than surfaces with a regular cross section or smooth surface, the resultant fibers had a uniform continuous coating of binder. Also, approximately 95 percent of the fibers were unbonded to one another by the binder material. The dried fiber can then easily be air laid in a laboratory pad former. Also, the fiber may be air laid while wet into a web.

In addition, the dried or wet coated fiber obtained in this manner can be blended with uncoated

fiber, for example, in a ratio of 1/3 coated fibers to 2/3 uncoated NB-316 fibers. This blend can be air laid and thermobonded into a web or other product.

A wide variety of other dyes and binders would also be suitable, including Synthemul 40-850 emulsion, available from Reichhold Chemical Corporation. Primacor 4990 ethylene acrylic acid copolymer solution from Dow Chemical Corporation is another example of a binder to which dye may be added and applied to fibers. Primacor is a hydrophobic, somewhat oleophilic thermoplastic binder. Therefore, a Primacor coated fiber is capable of absorbing oil without water.

Cellulose fibers having 5 percent, 7 percent, 10 percent, 20 percent, 30 percent and 50 percent by dry weight Synthemul 40-800 coating without dye have been manufactured using the described method. It is only at levels of about 7 percent that a continuous coating of the fibers is achieved. At 5 percent, the binder material was present as non-interconnected areas or blobs on the surface of the fibers. These percentages are the percent of dry weight of the fiber and binder combination which is the binder. In a recirculating system, to achieve higher percentages of the binder concentration, the fibers can be recirculated in the loop during liquid binder application for a longer time. Pads made in the above manner with 35 percent and 45 percent Synthemul 40-800 binder, respectively, and without the dye, had tensile indices of respectively 1.98 and 1.99 N-m/g at a 0.06 g/cc density. Synthemul is a more hydrophilic binder than Primacor. Also, Elvace 40-712, available from Reichhold Chemical Corporation, an ethylene vinyl acetate, has also been tested as have a number of other binder materials. These tests have all confirmed that substantially unbonded individualized fibers coated with a substantially continuous coating of binder material can be produced in accordance with the method of the present invention. In addition, dye can be added to each of these binders with similar results being expected.

EXAMPLE 2

Thermoset materials, without dye, have been used in accordance with example 1 to coat fibers to the desired percentage. For example, a mixture of polymeric methylene diisocyanate (PMDI) resin, such as PAPI 2027 from Dow Chemical Corporation and propylene carbonate from Arco Chemical Corporation can be sprayed onto the fibers. Dioctyl sodium sulfosuccinate may be used as a surfactant in this case. Cascophen WC04 from Borden Chemical Corporation is a specific example of a suitable phenolic resin. Still another example of a specific thermoset resin is Chembond 2509 from Chembond, Inc. However, the invention is not limited to specific thermoset binders.

Thus, fibers have been introduced into loading zone 20 and entrained. As the fibers traveled past the material applying zone 30, nozzles applied the thermoset resin to the fibers. Dye may be included in these binders, such as explained above in connection with example 1. To increase the weight percentage of thermoset resin, the fibers may be recirculated past the nozzles a plurality of times. Also, the lengths of the material zone and number of nozzles may be extended to enhance the rate at which the fibers are coated.

Again, resin in an amount of about 7 percent of the resin, fiber and dye combination is expected to be required to provide a continuous sheath or coating of thermoplastic material. Very high weight percentages of thermoplastic resin, measured in the same manner, can be achieved with 90 percent and higher concentrations expected.

EXAMPLE 3

In accordance with this example, functional materials in particulate form are adhered to the binder and dye coated fibers. A binder concentration of 7 percent would adhere some particulate material to the fibers, but at binder concentrations of 20 percent of the total dry weight of the binder, fiber and additives, and higher, much better adhesion occurs.

Fibers can be produced in a recirculating loop of the form shown in Fig. 1. In processing the fibers, a sufficient amount of dye containing binder material can be added to the air entrained fibers to produce the desired concentration. The recirculation blower can then be momentarily turned off and the particulate material added to the system at the fiber loading zone 20. Recirculation of the materials through the loop can then be recommenced to mix the particles with the still wet and entrained fibers. Continued circulation of the fibers would result in partial drying of the binder and adhesion of the particles to the fibers.

In a first more specific example, fibers coated with 20 percent dye containing Synthemul 40-800 (the percentage being the percent of binder in the dry fiber, dye, pigment, and binder combination) can be mixed with a granular pigment material, such as titanium dioxide. Various amounts of titanium dioxide can be added to the fibers, including an amount which is sufficient to be 50 percent of the dry weight of the binder, dye, fiber and titanium dioxide combination. This material would be useful, for example, in paper making processes with the pigment and dye cooperating in coloring the paper. Similarly, fire retardant particulate materials, such as alumina trihydrate and antimony oxide may be adhered to dye containing binder treated fibers for use in preparing fire retardant materials, such as pads, colored paper and other products.

To produce an electrically conductive material, a conductive particulate material (such as 60-80 percent by weight of the binder fiber and additive combination) may be adhered to the fibers by the binder. Powdered metallic materials and carbon black are examples.

For use in manufacturing abrasive pads and the like, abrasive particulate materials, such as ceramic powders, metallic powders, or grit, may be secured to the fibers by the binder material.

Also, paper making additives, such as acidular particles of clay, talc, mica and so forth, may be adhered to the fibers. For example, approximately 50 percent by weight of the binder, fiber and additive content may be made up of these additives.

Oleophilic materials, such as polynorbornene in a desired concentration may be adhered to the fibers. Norsorex from Norsorlor, a division of CdF Chimie of Paris, France, is one example of such a material. Typically a fugitive surfactant is used in this case. Like the other particulate materials, these materials may be added in varying percentages.

In addition, more than one type of particle may be bound to the fibers if the functional characteristics of more than one particulate material are desired.

Again, preferably the binders are of a polymeric heat bondable type (for example thermoset or thermoplastic binders) so that they may be subsequently heat bonded, with or without other fibers, in manufacturing a product. However, inorganic materials, such as dye containing liquid sodium silicate, in an amount sufficient to provide a substantially continuous coating of the fibers may also be used to adhere particles to the dyed fibers. Although such materials are not used in binding fibers together during subsequent processing, they are capable of binding particles to the fibers and thus in this sense can be called binders. In addition, these materials, when coated on the fibers, add characteristics to the fibers. For example, silicon dioxide increases the wetabilitv of the fibers.

EXAMPLE 4

This example is like example 3, except that super absorbent particles are adhered to the fibers by the dye containing binder material. These super absorbent particles are well known in the art. Various amounts of super absorbent particles can be successfully adhered to the fibers, including from 15-50 percent of the dry weight of the resultant fiber, binder and additive combination.

Lower percentages are also possible as are higher percentages. A specific example of super absorbent particulate material is Sanwet 1M-1000, available from Celanese Corporation. The resulting dyed fibers, when incorporated in a product such as a diaper, provide a color keyed visual indication of the super absorbent particle containing area of the diaper. Thus, for example, visual confirmation of the uniform distribution of the super absorbent particles at the desired location within the diaper can be achieved.

In one more specific example, rather than stopping the fibers to permit addition of the particulate material, super absorbent particles have been fed into the air stream containing the entrained fibers immediately following the binder application zone. In this example, dye was not used, but similar results are expected with the dye. The resultant material had fiber bonded to the super absorbent particles so as to contain the super absorbent particles in the resultant fluff. Yet, the fibers which were not attached to the particles were substantially unbonded to one another. The dried fluff was then air laid into a web and thermobonded. The web was tested for absorbency and found to be equivalent to an unbonded product, but with virtually 100 percent containment of the super absorbent particles. In addition, the containment of the super absorbent particles within the fibers prior to thermobonding was also excellent. Also, a very uniform distribution of super absorbent particles was present in the resulting web and enhanced the water absorbing characteristics of the web. Consequently, the fibers can be stored and transported for subsequent use in products without significant loss or migration of super absorbent particles.

EXAMPLE 5

In accordance with this example, the dye containing binder can be mixed with a blowing agent, such as Azodicarbonamid, and applied to the entrained fibers. When the fibers are subsequently heated, nitrogen, carbon

dioxide, and/or other gases would be released to produce a foamed coating of the fibers. These foam coated and dyed fibers can then be used in manufacturing, such as in the manufacturing of insulated paper board.

EXAMPLE 6

In accordance with this example, the dye containing binder may be a hydrophobic resin or latex material with the particles hydrophobic; the dye containing binder may be of a hydrophobic material with the particles hydrophilic; the dye containing binder may be a hydrophilic material with the particles hydrophobic; or the dye containing binder may be a hydrophilic material with the particles hydrophilic. A fugitive surfactant is typically used when water based binders are used and the fibers or particles are hydrophobic.

Thus, dye containing Primacor may be used with hexanol as a surfactant as a hydrophobic binder. Although variable, the surfactant is typically between one and two percent, based upon the Primacor solids. As another example, dye containing PMDI may be used as a hydrophobic binder (see example 2). While Primacor and PMDI do have a tendency to absorb oil to a limited extent, they are not optimum oil absorbing materials. By attaching polynorbornene particles to the fibers, dyed fibers having an enhanced capacity for oil absorption may be produced as the polynorbornene in effect acts like a super absorbent for oil.

An example of a hydrophobic dye containing binder with a hydrophilic particulate material would be fibers coated with dye containing Primacor or dye containing PMDI with super absorbent particles adhered to the fibers by the binder. For example, fibers containing a 20 percent dye containing Primacor binder, 40 percent by weight super absorbent particles, and 40 percent by weight fiber, can be produced. These percentages would be of the total dry weight of the binder, fiber and additive combination.

An example of a hydrophilic dye containing binder with hydrophobic particles would be dye containing

Synthemul 40-800 as a binder and polynorbornene as the particles.

Finally, an example of a hydrophilic dye containing binder with hydrophilic particles is dye containing Synthemul 40-800 as a binder and super absorbent particles as the hydrophilic material.

EXAMPLE 7

The dye containing binder may also be comprised of a thermoplastic binder material together with plasticizer particles or liquid which cause the polymer to soften when subjected to heat. A specific example of a liquid plasticizer is dioctyl phthalate. A specific example of a particulate plasticizer is sold under the brand name Santowax from Monsanto, Inc.

EXAMPLE 8

In accordance with this example, the fibers may be coated with plural binder materials. For example, the first dye containing binder material may be a thermoset binder material, such as phenolic resin, which can be applied to the fibers to increase their strength and rigidity. Cascophen WC04 is an example of such a resin. This binder can be applied using the apparatus of Fig. 1, Fig. 5 or Fig. 6. Following the application of the first binder, a second thermoplastic binder, such as Primacor, can be applied to the fibers. This second coating can be used to bond particulate materials to the fibers that would not satisfactorily bond to a thermoset coating. During subsequent use of the fibers, they may be heated to the hot tack temperature of the outer binder coating for purposes of heat fusing the fibers. However, because the thermoset coating withstands higher temperatures, its integrity as a fiber and contribution to the strength of the bicomponent fiber remains. The thermoset binder may subsequently be cured or the initial bonding temperature may be high enough to cure the thermoset binder while the thermoplastic binder is at a temperature at which bonding occurs. Thus, fibers having plural desired characteristics, such as a water repellant undercoating

and a highly bondable outer coating, can be produced, with or without adhered particulate materials. Also, by making the binders with dye of different colors, the final color of the fiber is affected by the combined effect of the two dye containing binder colors. In addition, shading can be accomplished by, for example, fully coating the fibers with the first dye containing binder and only partially coating the fibers with the second dye containing binder.

Kraton, a styrene butadiene block copolymer, available from Shell Chemical Corporation is an example of another hydrophobic and oleophilic binder material. This material does not form very strong bonds with other fibers. Therefore, a highly bondable first coating, such as of dye containing Primacor may be applied to continuously coat the fibers. Kraton in a lesser amount may then be applied to only partially coat the fibers. The exposed Primacor coated areas then enhance the bondability of these fibers.

EXAMPLE 9

This example demonstrates the applicability of the invention to coat cellulose fibers and fiber bundle material with a dye containing binder. Specifically, 1111 grams of a mechanically fiberized wood (10 percent moisture) can be placed in a recirculating conduit 24 with an in-line blower. The blower can be turned on to entrain the wood fibers. Also, 952 grams of Reichhold's Synthemul 40-800 (55 percent moisture) can be sprayed onto the fiber through a port in the conduit. After addition of the latex, the material can be shunted out of the loop 24, collected in a separator 60 and dried. Examination under a scanning electron microscope of a fiber product made in this manner without dye confirmed the presence of individual fibers and individual fiber bundles enclosed latex sheath with substantially no fiber to fiber, fiber to fiber bundle, or fiber bundle to fiber bundle agglomeration due to latex bonding. The dye is not expected to change this result. Having illustrated and described the principles of our invention with reference

to several preferred embodiments and examples, it should be apparent to those of ordinary skill in the art that such embodiments of our invention may be modified in detail without departing from such principles. We claim as our invention all such modifications as come within the true spirit and scope of the following claims.

CLAIMS

1. A fiber product comprising fibers with at least a partial coating of a mixture of a binder material and a dye.

2. A fiber product according to claim 1 in which the dye is water insoluble.

3. A fiber product according to claim 1 in which the binder material is at least about seven percent of the combined dry weight of the first binder material and fibers.

4. A fiber product according to claim 1 in which the binder material is at least ten percent of the combined weight of the first binder material and fibers.

5. A fiber product according to claim 1 in which the binder material is from thirty percent to fifty percent of the combined weight of the first binder material and fibers.

6. A fiber product according to claim 1 in which the binder material is a polymeric material.

7. A fiber product according to claim 1 in which the binder material is heat bondable.

8. A fiber product according to claim 1 including a solid particulate material adhered to the binder material to thereby bind the second solid particulate material to the fibers.

9. A fiber product according to claim 1 in which the binder material is heat bondable and the product is combined with other fibers and thereafter heat bonded.

10. A fiber product according to claim 1 in which a major portion of the fibers are unbonded.

11. A fiber product according to claim 1 in which the fibers are substantially unbonded.

12. A fiber product according to claim 1 including plural binder materials.

13. A fiber product comprising a substantial majority of unbonded fibers coated with a substantially continuous coating of a binder and water insoluble dye,

the binder being heat bondable and adhering the dye to the coated fibers.

14. A fiber product according to claim 13 including coated fibers mixed with uncoated fibers and heat bonded to form a web.

15. A fiber product according to claim 13 in which the fibers comprise wood pulp fibers.

16. A fiber product according to claim 15 in which the fibers comprise chemical wood pulp fibers.

17. A fiber product according to claim 15 in which the fibers include individual fibers and fiber bundles.

18. A fiber product comprising wood pulp fibers with at least a partial coating of a mixture of a binder material and a dye.

19. A fiber product according to claim 18 which comprises paper.

20. An individual wood pulp fiber with at least a partial coating of a mixture of a binder material and a dye.

21. An individual wood pulp fiber according to claim 19 with a continuous coating of a mixture of a binder material and a dye.

FIG. 1

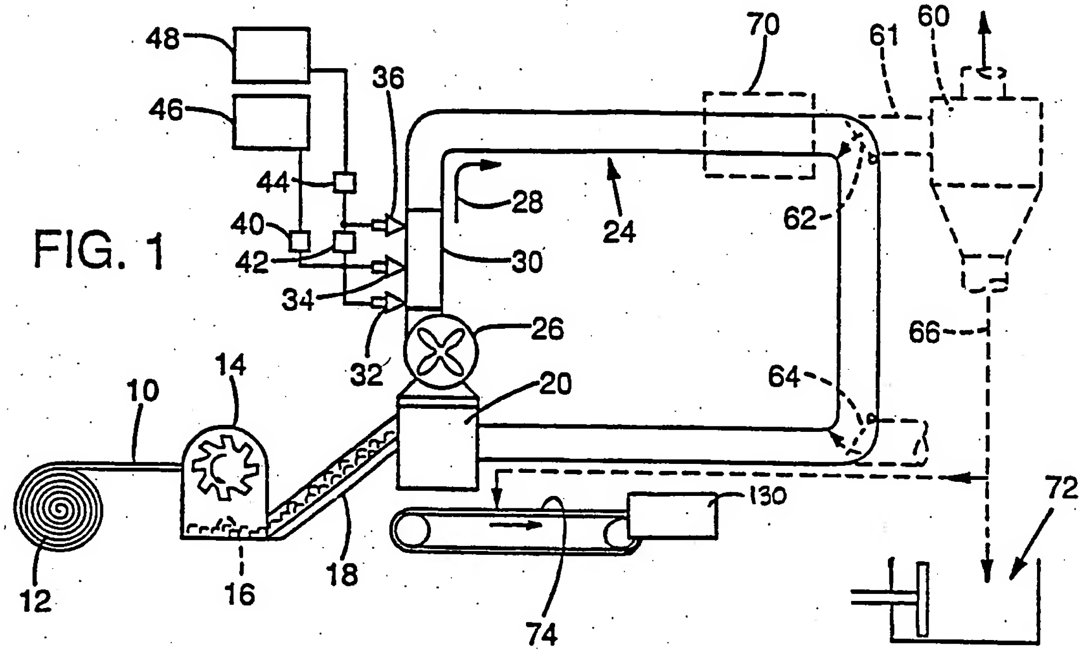


FIG. 2

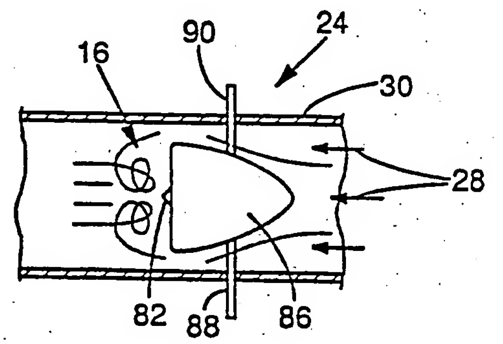


FIG. 3

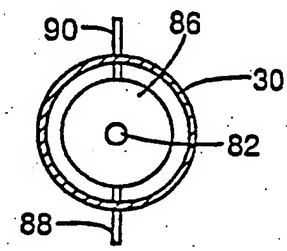


FIG. 4

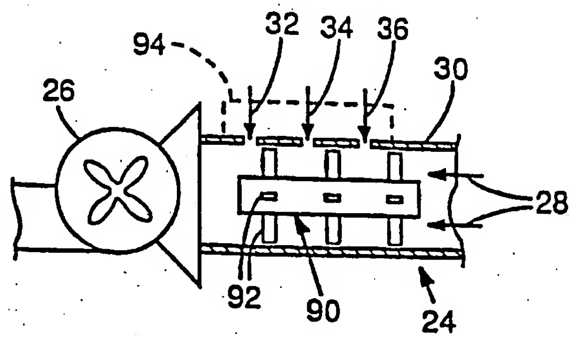


FIG. 5

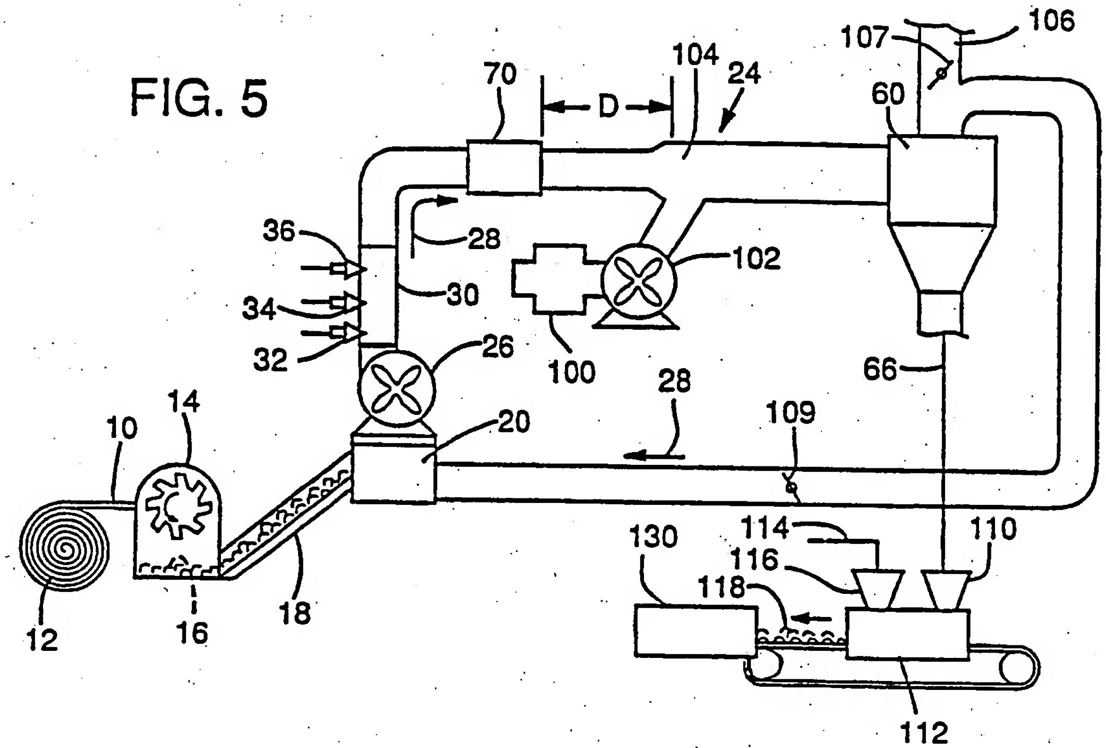
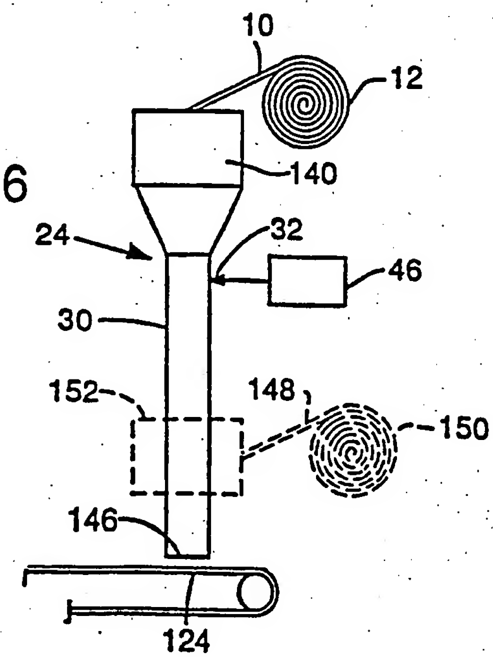

106
107
104
24
70
D
60
36
28
102
34
30
32
26
100
66
28
14
109
10
20
130
114
110
116
118
12
16
18
112

FIG. 6


10
12
140
24
32
46
30
152
148
150
146
124

INTERNATIONAL SEARCH REPORT

International Application No PCT/US90/01506

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [3]

According to International Patent Classification (IPC) or to both National Classification and IPC

INT CL 5 B32B 5/16
US CL 428/283, 288, 296

II. FIELDS SEARCHED

Minimum Documentation Searched [4]

Classification System	Classification Symbols
US	428/283, 288, 296

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [5]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [14]

Category *	Citation of Document, [16] with indication, where appropriate, of the relevant passages [17]	Relevant to Claim No. [18]
A	US, A, 2,601,597 (DANIEL) 24 JUNE 1952; See entire document.	1-21

* Special categories of cited documents: [15]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search [2]	Date of Mailing of this International Search Report [2]
05 JUNE 1990	19 JUL 1990
International Searching Authority [1]	**Signature of Authorized Officer** [20]
ISA/US	for Andre Robinson W. J. VAN BALEN